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13. ABSTRACT (Maximum 200 words) <p>THE PROPOSAL IS SUBMITTED IN RESPONSE TO A VERBAL REQUEST FROM THE U.S. ARMY MEDICAL RESEARCH & DEVELOPMENT COMMAND. THE PROPOSED PROGRAM IS A CONTINUATION OF THE WORK BEGUN UNDER CONTRACT DAMD-17-75-C-5069. A PORTION OF THE PROPOSED EFFORT IS UNINTERRUPTED CONTINUATION STUDIES OF EXPERIMENTS CURRENTLY UNDERWAY (E.G., PLANT GROWTH & DIMP LYSIMETER TYPE) & THE REMAINING PORTION IS WORK TO BE INITIATED (E.G., DCPD LYSIMETER STUDIES). CURRENTLY A SELECT GROUP OF PLANTS ARE BEING EXPOSED TO DIMP & DCPD IN A SOIL CULTURE SYSTEM TO DETERMINE THEIR EFFECTIVE LEVELS AS TO PHYTOTOXICITY & BIOACCUMULATION IN THIS GROWTH MEDIUM. COMPLETION OF THIS TASK, AS WELL AS THE UTILIZATION OF SEEDS FROM THIS TASK IN FURTHER STUDIES, ARE INCLUDED IN THE PROPOSED EFFORT. A SECOND AREA OF STUDY CURRENTLY UNDERWAY, & TO BE CONTINUED, RELATES TO THE MANNER IN WHICH THE CONTAMINANT COMPOUNDS MIGRATE THROUGH SOIL.</p> <p style="text-align: center;">(JAS QUALITY INSPECTED 2)</p>				
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DETERMINATION OF DECONTAMINATION CRITERIA

DIMP AND DCPD (U)

Rocky Mountain Arsenal
Information Center
Commerce City, Colorado

Report No. 1953-01(21)MP

Contract DAMD-17-C-5069

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P. A. O'Donovan

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▼ - Satisfactory Progress - on schedule

Determination of Decontamination Criteria - DIMP and DCPD Research Task Schedule

Progress on items proposed for action during April, 1977 is discussed in the following paragraphs.

Full Scale Lysimeter Tests

All of the lysimeter irrigation experiments have been terminated and the final multiple core samples are being analyzed for DIMP content. The lysimeters were divided into two groups, which consisted of five lysimeters each. The five lysimeters were filled, one each, with the following types of soil:

- | | | |
|--------------|---|-----------------|
| 1. Chino | - | sandy clay loam |
| 2. Brawley | - | silty clay |
| 3. Ventura | - | clay loam |
| 4. Fullerton | - | sandy loam |
| 5. Walnut | - | clay loam |

Group 1 was subjected to irrigation on a regular basis with 20 ppm (parts per million) DIMP (diisopropyl methyl phosphonate). Group 2 had 20 ppm DIMP intimately mixed with the top 1 foot layer of soil and subsequently irrigated with regular additions of distilled water. The general trend in DIMP concentrations in group 1 core samples has been for the surface layer to be relatively high and for the successively deeper layers to rapidly fall off in concentration. The multiple samples analyzed here and in group 2 will give a more significant basis for the reliability of these concentration profiles.

The raw data from the group 1 terminal samples are shown in Table 1.

Taking the average of each of the sets of figures from Table 1 gives the more concise data in Table 2. These data are plotted in Figures 1 through 5 and illustrate the above stated trends.

The group 2 lysimeter soils have been sampled and are currently undergoing analysis. In this case as in Group 1 cores were taken from four separate

Table 1

DIMP Content of Soil samples (ppm) 426 Days

Group 1

Depth	VENTURA				CHINO				FULLERTON				WALNUT				BRAWLEY			
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
0 (surface)	22.0	22.4	24.7	44.5	38.3	27.4	10.0	40.0	21.3	23.7	14.3	34.9	49.0	26.2	40.3	17.5	14.8	8.6	15.8	34.4
0 - 6"	5.7	3.1	11.3	5.7	8.5	7.4	5.9	7.7	6.8	3.9	13.2	10.9	16.2	6.2	4.6	9.1	*	5.9	7.8	5.7
6 - 12"	3.8	3.0	3.9	8.5	6.4	7.1	6.6	8.3	6.8	3.9	5.6	12.0	6.9	5.2	11.1	9.7	*	*	5.6	11.6
12 - 18"	1.5	1.5	3.0	4.0	5.5	6.1	4.4	5.3	6.3	3.1	7.1	7.9	6.2	3.8	5.9	12.7	6.9	6.4	9.1	5.7
18 - 24"	3.2	2.1	2.7	5.3	4.6	3.8	4.7	7.7	4.0	3.1	5.9	10.4	4.5	3.8	7.4	8.1	4.5	8.0	9.7	8.1
24 - 30"	1.4	2.6	1.9	3.6	3.4	6.4	5.4	4.4	4.4	3.3	6.0	9.1	5.4	5.1	5.3	10.2	6.4	6.8	8.8	5.6
30 - 36"	0.8	2.2	2.8	5.0	3.0	1.2	5.3	4.5	6.2	2.9	13.6	10.5	5.5	5.1	7.5	12.0	6.2	4.8	7.2	8.0
36 - 42"	1.6	2.3	2.5	11.5	4.9	1.7	5.4	4.4	6.0	2.0	7.9	7.3	6.7	4.1	6.3	9.2	5.0	5.2	7.3	5.4
42 - 48"	1.7	2.6	3.1	4.0	2.6	1.6	4.3	3.4	5.1	2.4	9.6	7.3	5.5	4.4	11.5	13.6	5.7	3.7	6.4	8.3
48 - 54"	1.7	2.3	0.9	6.2	2.6	2.0	5.3	4.2	3.1	3.4	12.3	6.8	5.2	4.2	7.5	14.3	4.3	4.2	5.9	5.4
54 - 60"	2.0	3.7	1.5	5.1	*	10.6	5.4	4.3	5.1	2.5	6.9	5.1	4.1	7.4	4.9	8.6	4.3	4.2	7.5	7.0

* < 0.1 ppm

Table 2

Average DIMP Content of Soil Samples (ppm)

426 days, Group 1

Depth	Ventura	Chino	Fullerton	Walnut	Brawley
0 (surface)	28.4	28.9	23.6	33.3	18.4
0-6"	6.5	7.4	8.7	9.0	6.5*
6-12"	4.8	7.1	7.1	8.2	8.6*
12-18"	2.5	5.3	6.1	7.2	7.0
18-24"	3.3	5.2	5.9	6.0	7.6
24-30"	2.4	4.9	5.7	6.5	6.9
30-36"	2.7	3.5	8.3	7.5	6.6
36-42"	4.5	4.1	5.8	6.6	5.7
42-48"	2.9	3.0	6.1	8.8	6.0
48-54"	2.8	3.5	6.4	7.8	5.0
54-60"	3.1	6.8*	4.9	6.3	5.8

* Group contains some samples with no detectable DIMP i.e., < 0.1 ppm.

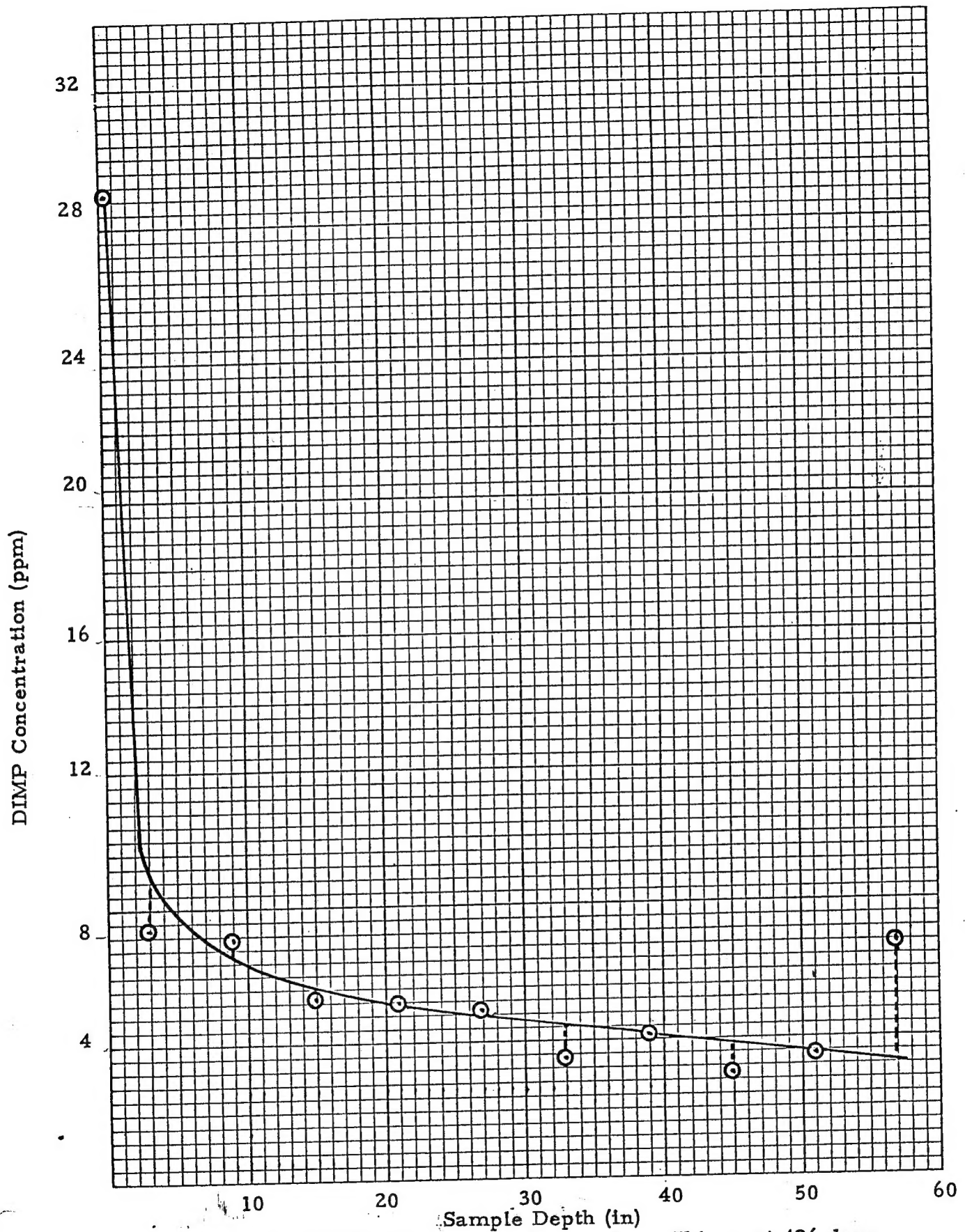


Figure 1. DIMP Content of soil samples, Chino, at 426 days, Group I.

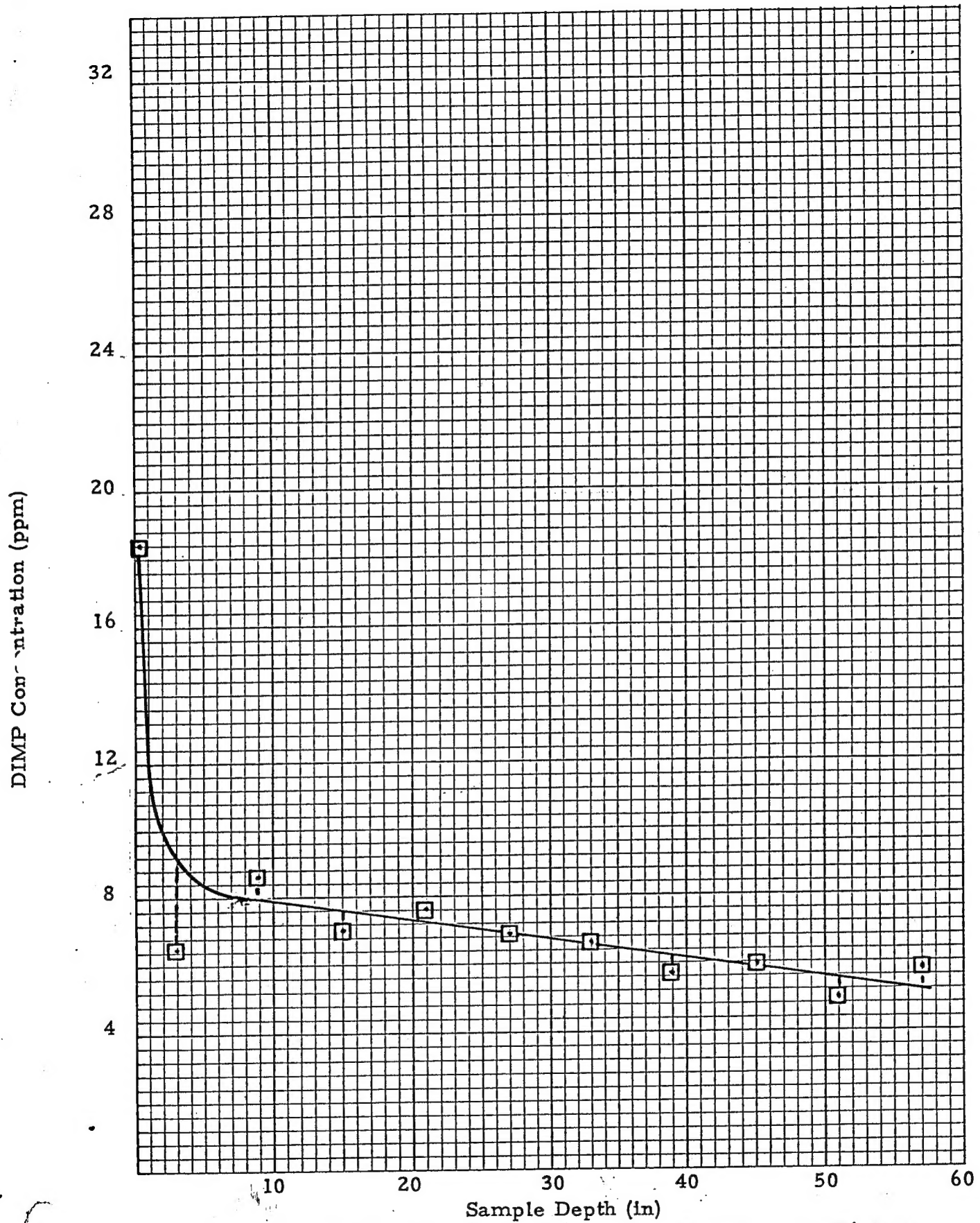


Figure 2. DIMP Content of soil samples, Brawley, at 426 days, Group I

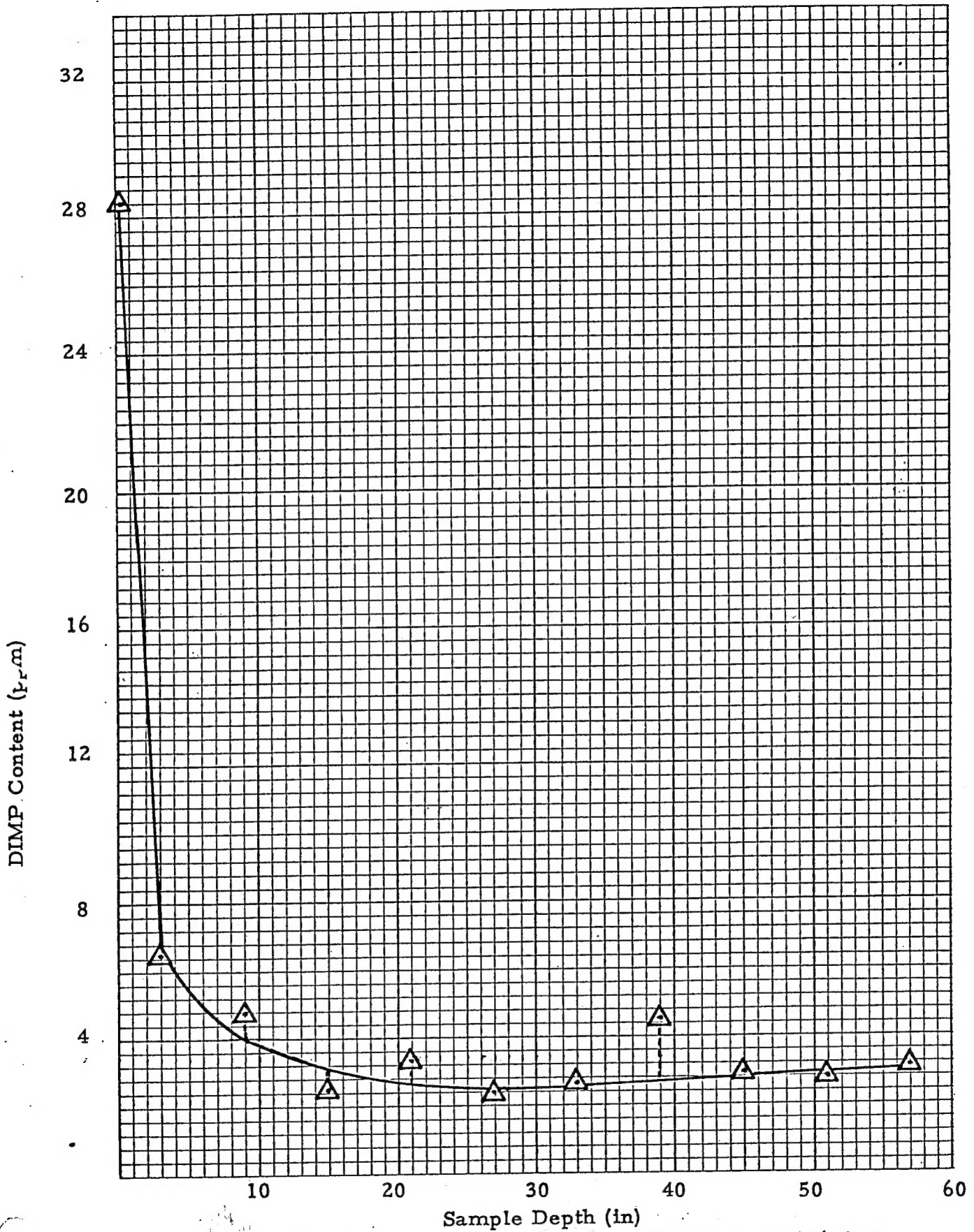


Figure 3. DIMP Content of soil samples, Ventura, at 426 days, Group I.

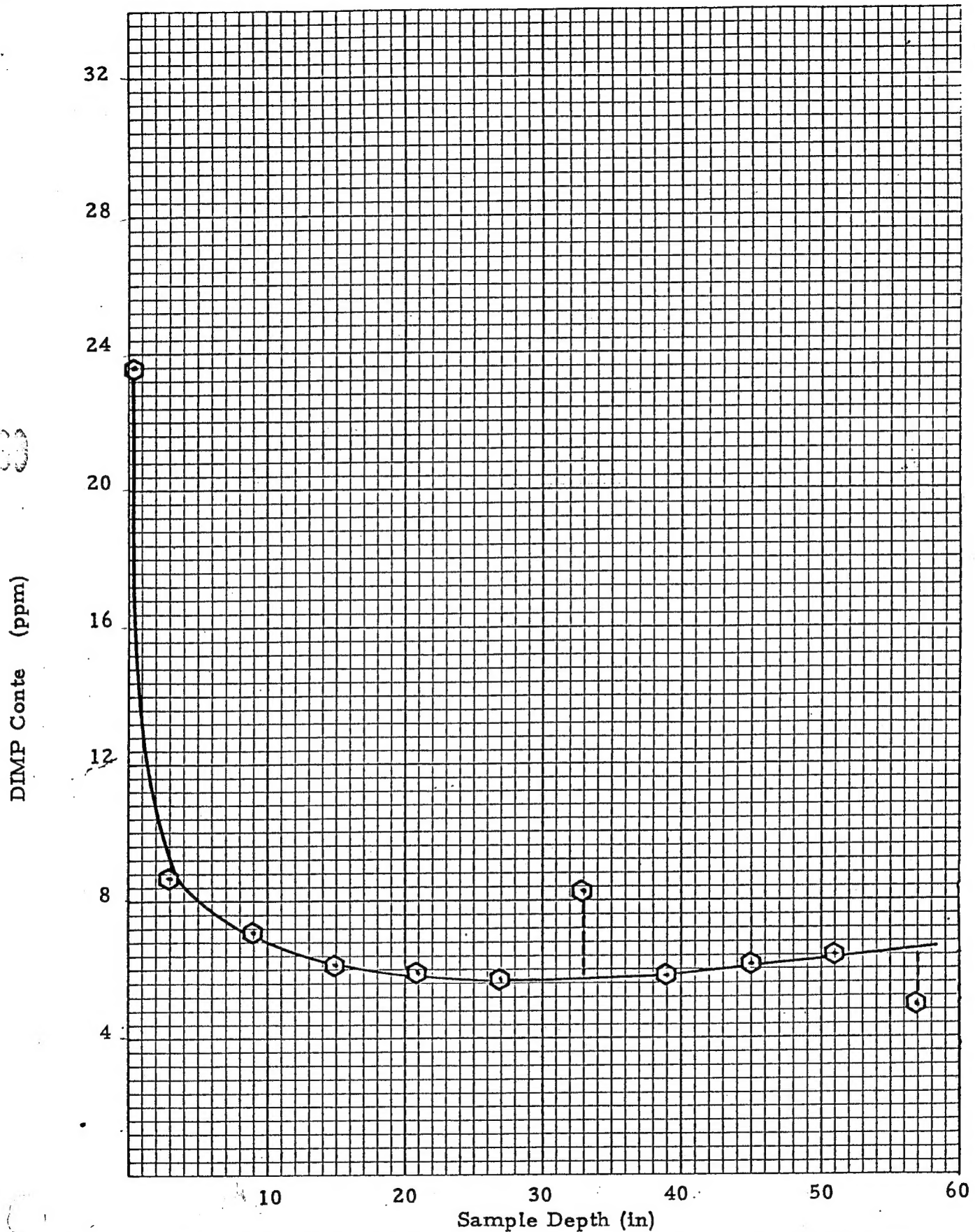


Figure 4. DIMP Content of soil samples, Fullerton, at 426 days, Group I.

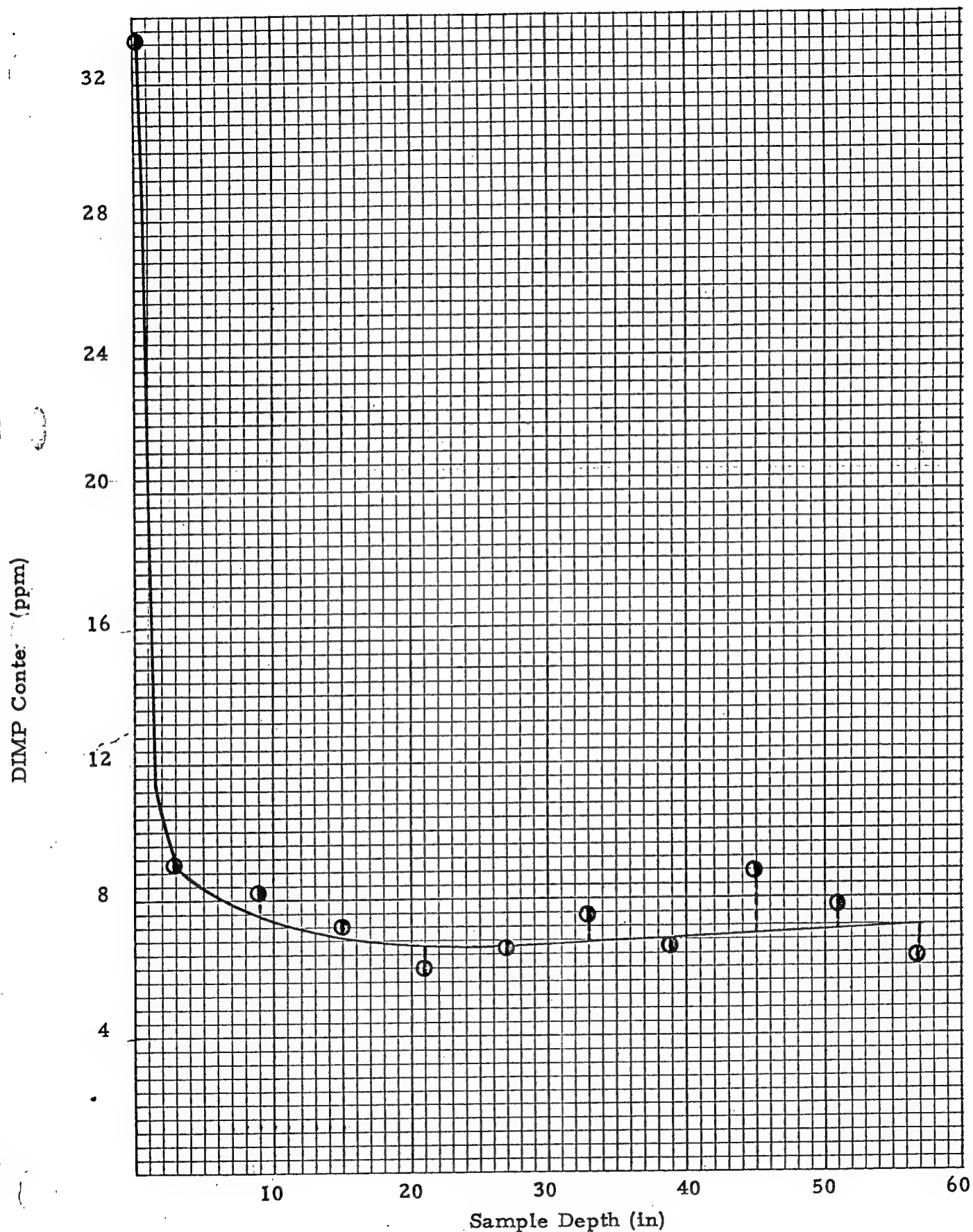


Figure 5. DIMP Content of soil samples, Walnut, at 426 days, Group I.

locations in each lysimeter. This data will be included in a future report.

Soil Culture Experiments

Harvesting of the broad range (0-1000 ppm) soil growth tests is completed. Data on the biomass of the sugar beet, alfalfa, carrot and bean are given in tables 3, 4, 5 and 6. Plotting the mass data for the normally edible portion of the plants gives the graphs shown in figures 6, 7, 8 and 9. In general this data shows that for sugar beets and alfalfa 50 ppm DIMP results in poorer than control yields and for carrots and beans somewhere between 50 and 100 ppm DIMP gives poorer than control yields. In all cases the yields of DCPD treated plants are significantly higher than the DIMP plants and generally higher than the control plants.

Radioactive Tracing of Soil Contamination

Further data is available from the radioactive tracer experiments described in 1953-01(18)MP. The most recent data is shown in Table 7. This data confirms the preliminary data in 1953-01(19)MP which generally indicated that passing air over columns of dry soil impregnated with either radioactive DIMP or DCPD, at 20 ppm, does not significantly lower the concentration of radioactivity in the soil.

Similar experiments using moistened soil conditions and larger diameter soil containers are currently underway and data from these tests should be available in a future report.

Table 3

Tabulation of Average Weight of
Plant Parts @ 201 Days of Age

Plant Type	Average Weight (g) of					Number of Plants in Average	Contaminant Type	Conc. of Contaminant in H ₂ O (ppm)
	Leaf	Stem	Root	Edible Root/Plant	Total Plant			
Sugar Beet	166.93	-	-	187.35	354.28	4	DIMP	Control
"	16.68	-	-	12.00	28.68	5	"	50
"	34.08	-	-	29.50	63.58	4	"	100
"	20.74	-	-	6.38	27.12	5	"	300
"	1.05	-	-	1.51	2.56	1	"	500
"	94.30	-	-	46.60	140.90	5	DCPD	Control
"	115.13	-	-	112.38	227.51	4	"	50
"	163.07	-	-	146.37	309.44	3	"	100
"	161.93	-	-	188.37	350.30	3	"	300
"	102.43	-	-	78.25	180.68	4	"	500
"	85.45	-	-	91.50	176.95	2	"	700
"	133.05	-	-	135.7	268.75	2	"	1000

Table 4

Tabulation of Average Weight of
Plant Parts @ 201 Days of Age

Plant Type	Average Weight (g) of					Number of Plants in Average	Contaminant Type	Conc. of Contaminant in H ₂ O (ppm)
	Leaf	Stem	Root	Edible Root/Plant	Total Plant			
Alfalfa	4.89	8.68	4.25	-	17.82	15	DIMP	Control
"	2.72	5.19	2.24	-	10.15	14	"	50
"	0.92	4.20	1.19	-	6.31	11	"	100
"	0.60	1.03	0.12	-	1.75	3	"	300
"	1.48	3.39	0.22	-	5.09	2	"	500
"	4.20	4.74	3.24	-	12.18	12	DCPD	Control
"	6.35	10.58	4.45	-	21.38	12	"	50
"	8.84	12.44	6.04	-	27.32	7	"	100
"	4.94	9.72	3.92	-	18.58	5	"	300
"	6.36	14.09	4.37	-	24.82	2	"	500

The 700 and 1000 ppm plants did not survive the experiment.

Table 5

Tabulation of Average Weight of
Plant Parts @ 201 Days of Age

Plant Type	Average Weight (g) of					Number of Plants in Average	Contaminant Type	Conc. of Contaminant in H ₂ O (ppm)
	Leaf	Stem	Root	Edible Root/Plant	Total Plant			
Carrot	1.29	1.54	-	17.01	19.84	9	DIMP	Control
"	0.75	1.33	-	19.65	21.73	10	"	50
"	0.17	0.50	-	0.05	0.72	2	"	300
"	2.15	0.84	-	0.40	3.39	1	"	500
"	2.49	3.18	-	17.49	23.16	8	DCPD	Control
"	7.80	11.40	-	39.40	58.60	1	"	100
"	5.37	10.03	-	50.57	65.97	3	"	300
"	3.87	9.58	-	63.23	76.68	6	"	500
"	4.30	7.35	-	36.65	48.30	2	"	700
"	4.42	6.40	-	50.70	61.52	4	"	1000

Table 6

Tabulation of Average Weight of
Plant Parts @ 201 Days of Age

Plant Type	Average Weight (g) of					Number of Plants in Average	Contaminant Type	Conc. of Contaminant in H ₂ O (ppm)
	Leaf	Stem	Root	Edible Fruit/ Plant	Total Plant			
Bean	2.13	9.83	1.17	9.67	22.80	3	DIMP	Control
"	3.00	34.50	7.30	22.30	67.10	1	"	50
"	9.10	15.00	1.85	4.95	30.90	2	"	100
"	25.30	29.80	14.90	21.50	91.50	1	DCPD	100
"	51.20	35.70	30.5	17.40	134.80	1	"	300
"	4.50	4.85	2.40	14.00	25.75	2	"	500
"	7.95	17.55	13.60	13.25	52.35	2	"	700
"	4.85	13.00	8.05	13.65	39.55	2	"	1000

1953-01-(21)MP

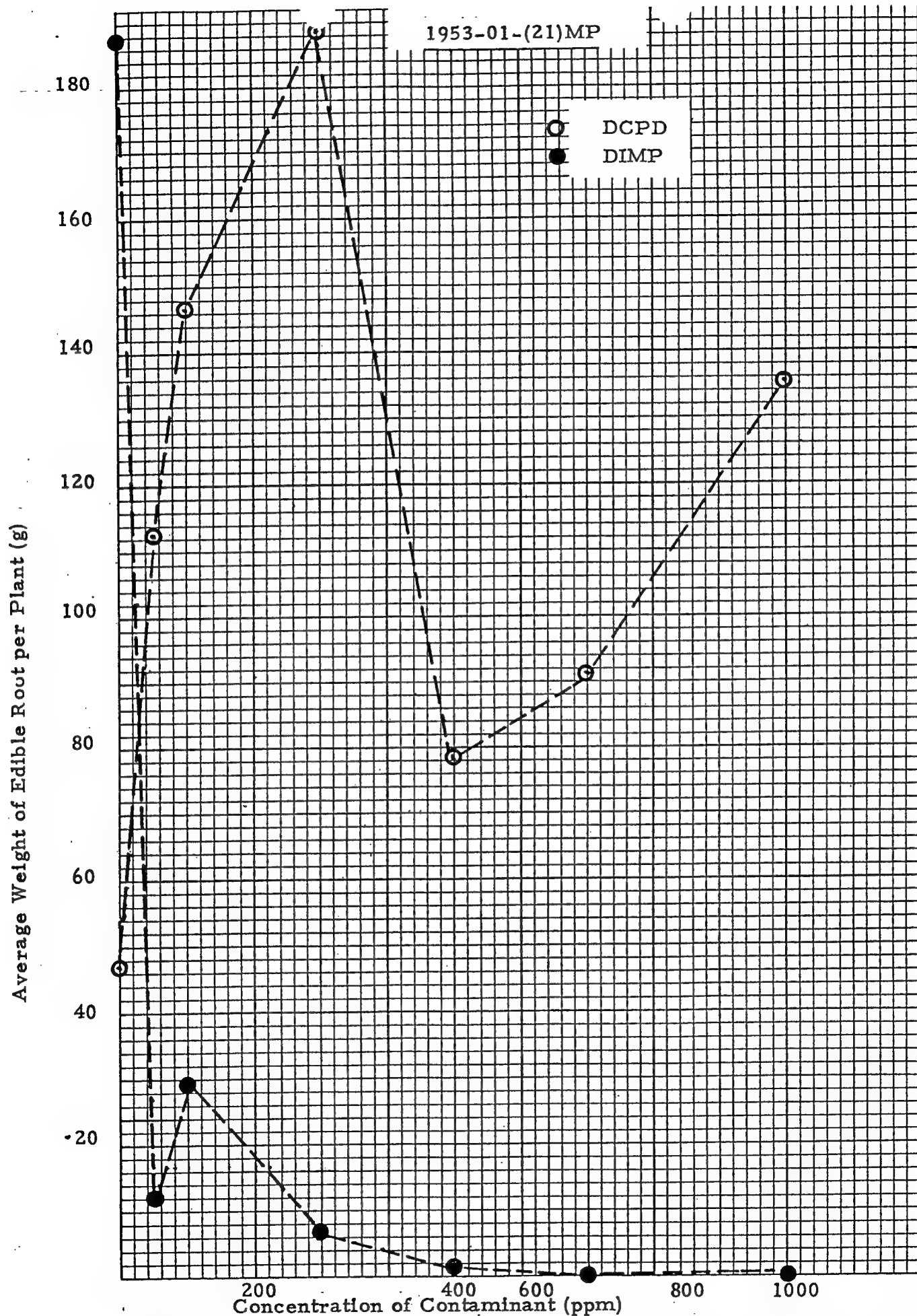


Figure 6. Average Yield of Sugar Beets Irrigated with DIMP or DCPD Contaminated Water. 14

Average Weight of Leaves Per Plant (g)

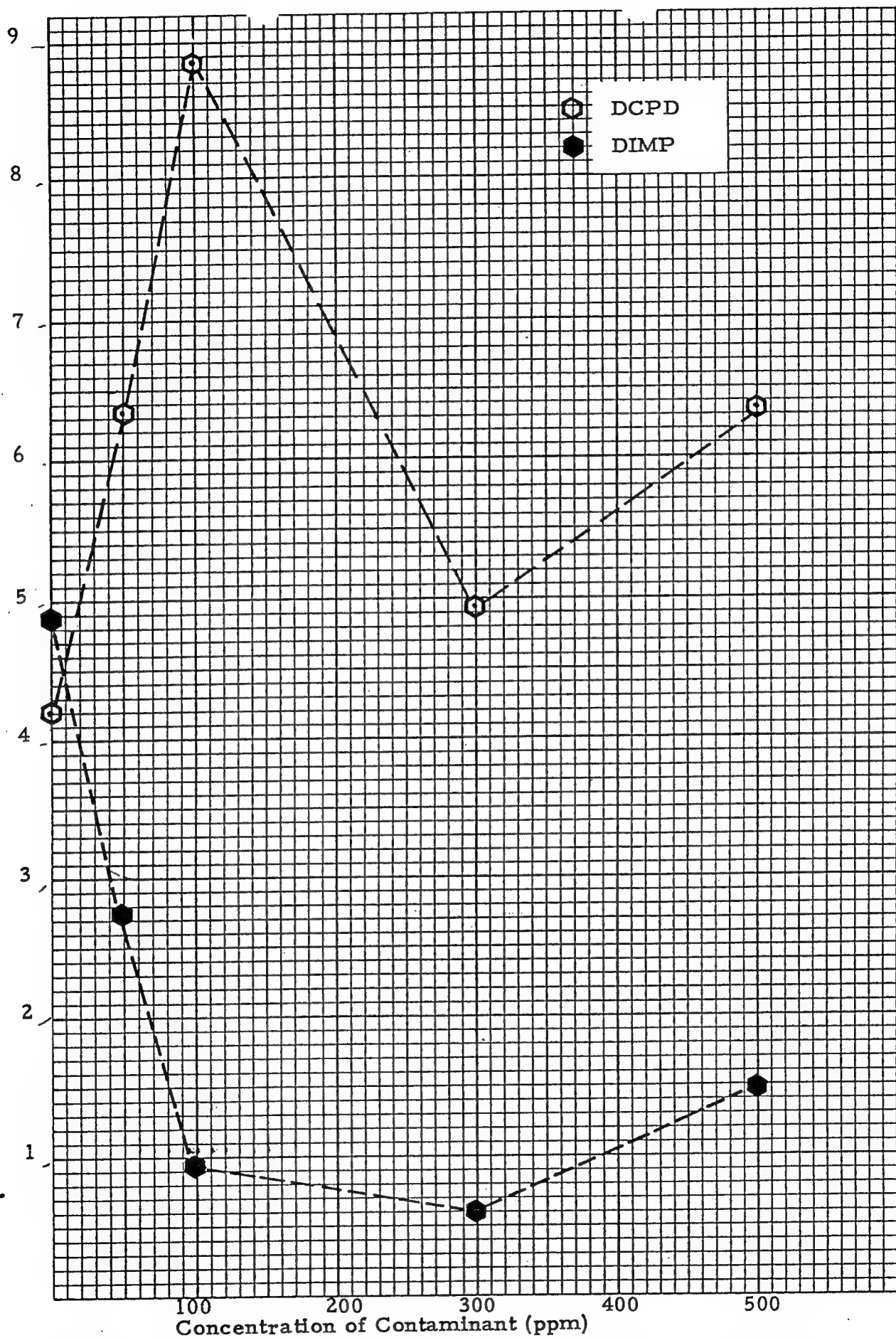


Figure 7. Average Yield of Alfalfa Irrigated with DIMP or DCPD Contaminated Water.

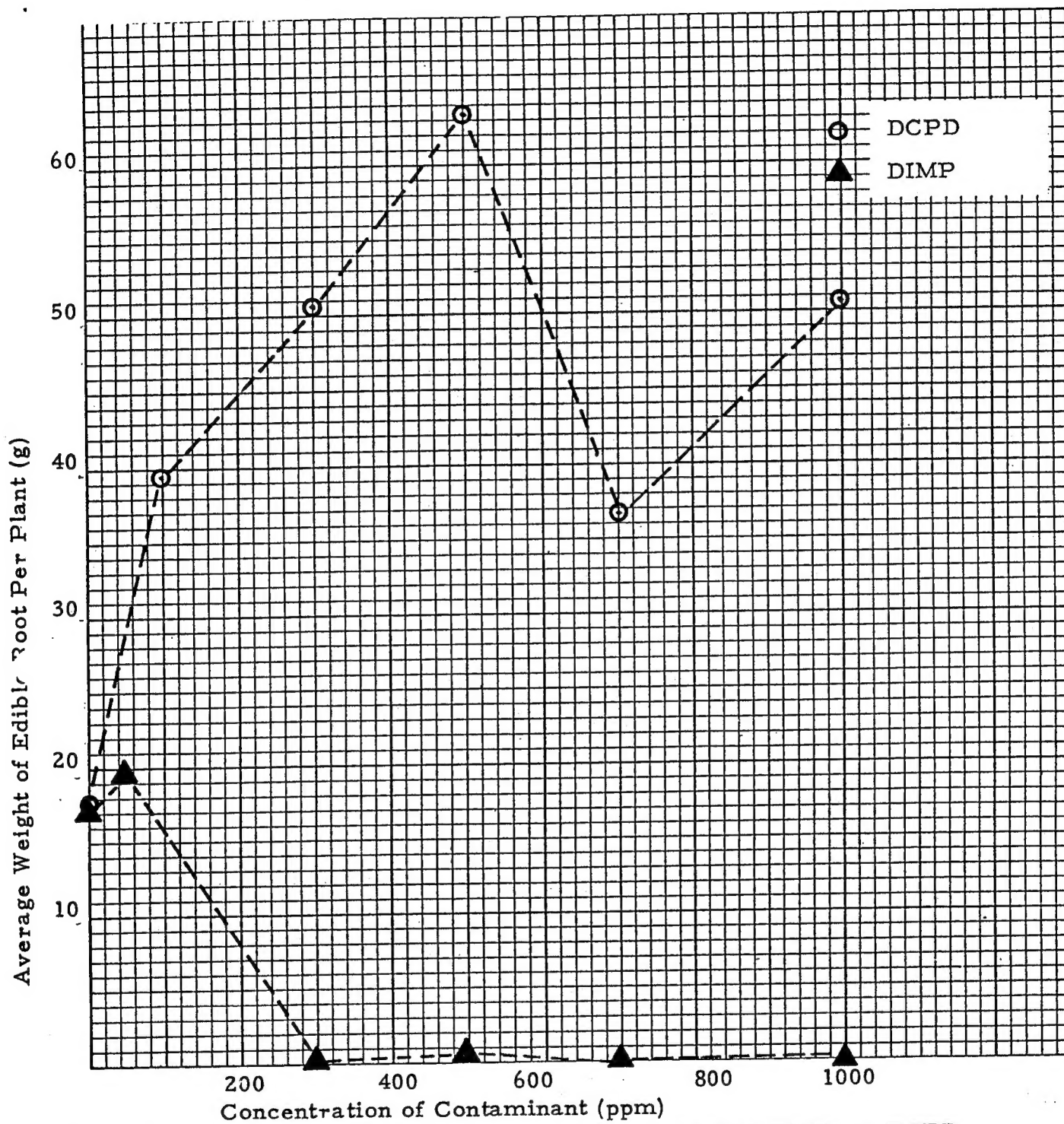


Figure 8. Average Yield of Carrots Irrigated with DIMP or DCPD Contaminated Water.

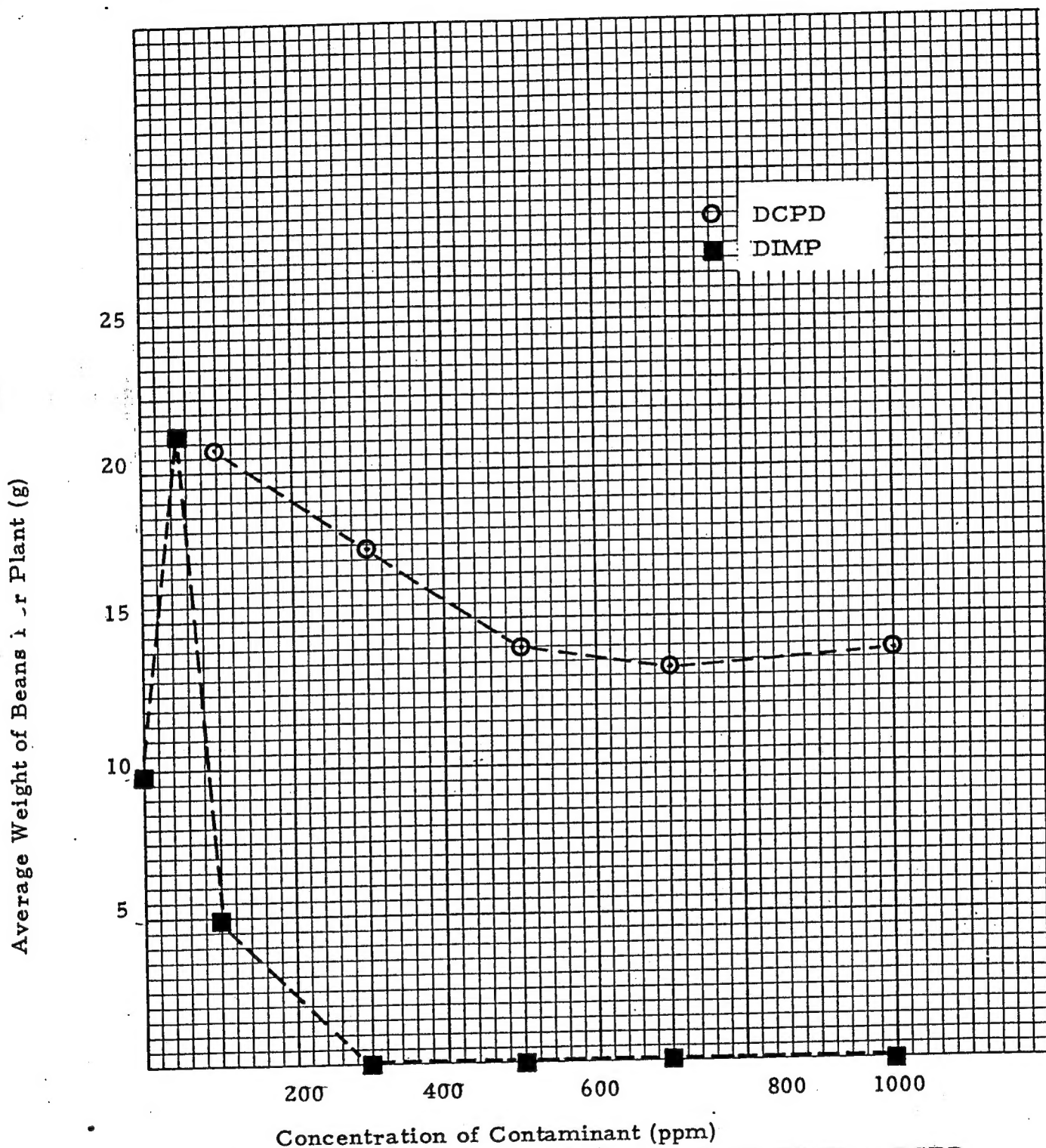


Figure 9. Average Yield of Beans Irrigated with DIMP or DCPD Contaminated Water.

Table 7

Scintillation Count Data From DIMP/DCPD Tracer Experiments in Fullerton Soil						
Sample No.	Description	Sample wt (g)	Radioactivity Calculated Found μ Ci μ Ci		% of Stock Rad. Re- covered	Air flow time @ 100 ml/min (hrs)
1	Stock DCPD Soil	5.0098	$8 \times 10^{-3} *$	$7.86 \times 10^{-3} *$	100	} 267
2	Stock DIMP Soil	6.1420	$3.37 \times 10^{-1} *$	$3.12 \times 10^{-1} *$	100	
3	0-1" Soil DCPD	11.9831		0.18	} 0.65	
4	1"-2" "	13.1534		0.18		
5	2"-3" "	12.3646		0.14		
6	3"-4" "	16.2240		0.14		
11	DCPD Trap	12.4104	0.4	0.01	165	} 231
7	0-1" Soil DIMP	13.9275		4.14	} 16.2	
8	1"-2" "	15.3755		5.00		
9	2-3" "	10.3126		3.20		
10	3-4" "	11.0975		3.82		
12	DIMP Trap	17.5540	16.9	0.03	104	
13	DIMP in Soil	17.1267	$3.37 \times 10^{-2} *$	$3.49 \times 10^{-1} *$	112	
14	DCPD in Soil	17.2577	$8 \times 10^{-3} *$	$7.90 \times 10^{-3} *$	101	
16	Dil. Stock DCPD 1:10	0.1027	$3.3 \times 10^2 *$		102	

* $\mu\text{Ci/g}$

PROPOSED ACTIVITY FOR MAY 1977

- o Terminate all experimental activities including final analyses of samples of both soil and plants.
- o Begin preparation of draft copy of project final report.